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# QUARTERLY STATUS AND TECHNICAL PROGRESS REPORT

Title: Evaluation of Spatial, Radiometric and Spectral Thematic Mapper Performance for Coastal Studies

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## 1. Problems

Only one TM image of our Delaware Bay test site was available (P014, R033, 12/13/82) and due to snow-cover it was unsuitable for marsh vegetation (biomass) studies. To solve the problem one of our Chesapeake Bay test sites was activated and an available high-quality TM image ordered (P015, R033, 11/02/82). Due to the delay in transmitting additional TM data from Landsat 4, two more scenes of adjacent test sites were ordered (P014, R032, 11/27/82 and P012, R031, 9/10/82). Pictures and tapes for all scenes have been received.

## 2. Acomplishments

Radiative transfer theory was used to model upwelling radiance for an orbiting sensor viewing an estuarine environment. The environment was composed of a clear maritime atmosphere, an optically shallow estuary of either clear or turbid water, and one of three possible bottom types: vegetation, sand, or mud. Upwelling radiance was calculated for each case in TM bands 1, 2, and 3 and MSS bands 4 and 5 using data available in the literature. A spectral quality index was defined similar to the equation for apparent contrast and was used to evaluate the relative effectiveness of TM and MSS bands in detecting submerged vegetation.

A portion of the November 02, 1982 Thematic Mapper image of Chesapeake Bay was enhanced using our ERDAS 400 System. The area included Harris Creek, Broad Creek, and a portion of the Choptank River. The enhanced image was compared with low altitude color aerial photography collected on August 02, 1982. The TM bands were first viewed individually to determine which ones contained water and submerged features information. Several three-band combinations were also viewed including 1-2-5, 1-3-5, 2-3-5, and 1-2-3.

During the following months we intend to continue modeling efforts in order to account for morphological characteristics within the submerged vegetation canopy. The model will be combined with field measurements in the Choptank River area. The results will be compared with what is found in the November, 1982 image as well as any future images when data acquisition continues.

## 3. Significant Results

If one considers only the spectral aspect of the problem, the effectiveness of a sensor to discriminate between submerged features is determined by the inherent contrast between the features and the absorbing and scattering properties of the water column and atmosphere. In optically shallow water, holding the atmosphere constant, the inherent contrast between submerged features appeared to be the most influential factor. As the optical depth of the water increased, the optimum sensor band for detecting a submerged feature shifted towards those for which the water was most transparent.

Perhaps the most significant result of this research thus far is the extent to which it has highlighted the need for optical data of high spectral resolution. We have become concerned about the variation in optical characteristics of natural waters and bottom features across sensor bands. This research has shown, for example, that under certain conditions the apparent contrast between two submerged features may decrease to zero at some intermediate depth and then increase for yet deeper depths. Without detailed knowledge of the variation in optical properties across sensor bands, this could not have been predicted.

A portion of the November 02, 1982 Thematic Mapper image was enhanced using the ERDAS 400 in an attempt to obtain a "quick look" at what submerged features could be detected. The enhancements were compared with low altitude color aerial photography collected on August 02, 1982. TM bands 1, 2, and 3 were found to contain water and submerged features information. TM band 1 contained a significant amount of noise and low contrast. TM band 2 appeared to contain the most amount of bottom information of the three bands. The contrast in TM band 2 was better than TM band 1. TM band 3, while having the least amount of noise and best contrast, contained a lesser amount of bottom information because of increased water absorption. Of the three-band combinations investigated, bands 1, 2, and 3 appeared to yield the most useable submerged features information. Several unique water signatures were identified which correlated with submerged vegetation shown in the aerial photography.

## 4. Publications

1). Ackleson, S. G. and V. Klemas. "Assessing Landsat TM and MSS Data for Detecting Submerged Plant Communities," LANDSAT-4 Early Results Symposium, NASA Goddard S. F. C., February 23-24, 1983.

2). Hardisky, M. A. and V. Klemas. "Remote Sensing of Coastal Wetlands Biomass Using Thematic Mapper Wavebands," LANDSAT-4 Early Results Symposium, NASA Goddard S. F. C., February 23-24, 1983.

## 5. Recommendations

If no TM data is available for any given test site, investigators should be encouraged to request TM data for other yet similar sites, until more data becomes available for the prime site. This procedure has helped us save much time as far as learning to analyze TM data and get good preliminary results.

## 6. Data Utility

All major wetland vegetation species can be clearly discerned in TM imagery. The spatial resolution of TM data appears to be better than 30 meters, i.e., it seems to be closer to 25 meters than 30 meters.

A significant amount of the submerged grass beds in the Choptank River/Chesapeake Bay are large enough to be resolved in TM data. In many cases, the number of pixels represented is on the order of 10. If it is possible to differentiate between submerged vegetation and other submerged features as well as water features, TM data would become quite valuable for inventorying submerged plants. At the present time, this is done by aircraft and aerial photography and in many cases is prohibitively expensive.